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MODULAR RAPID E-LEARNING FRAMEWORK (MORELF) IN DESKTOP VIRTUALIZATION ENVIRONMENT: An Effective Hybrid Implementation in Nurse Education

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ABSTRACT

Generally it is not easy for an instructor to prepare and deliver electronic courses via e-learning. Therefore it is necessary to work and develop an easy system. In this context module technology was used to for provide modularity in conducting educational development of e-learning course. Then, rapid e-learning was used for more quick and easy course development. In order to implement modular rapid e-learning, a desktop virtual environment was set up. Modular rapid e-learning was used by teachers and students in a one semester course and student success and reactions were evaluated. And also the overall hybrid system cost was calculated and reported. In implementation we combined modular course design with rapid e-learning and desktop virtualization in education of 3rd year nursing students for a one semester course. The effectiveness of this hybrid method was evaluated with respect to students' success, students' opinions and over all cost effectiveness. It was seen that the hybrid method was educationally more effective than traditional method comparing with previous year students' success and fit with students' requirements. The cost reduction was %41 comparing with traditional desktop and e-learning system.

Keywords: Modular design, rapid e-learning, desktop virtualization, course design, modular framework, e-learning modules.

INTRODUCTION

E-learning has attracted a lot of attention from researchers and practitioners. Various types of e-learning platforms and services have been introduced in different education institutions. However, there are many lacks in e-learning procedures. It is difficult to organize, update, maintain, and deliver e-learning courses (Guanl, Tan & Hua, 2009).

Many analyses have been made for e-learning solutions in education. One purpose of using e-learning is to support face-to-face education to increase students' success. While discussing e-learning in education a new e-learning model should be taken into the account which is called "rapid e-learning". This approach allows organizations to create e-learning more quickly, more easily and at lower price than possible conventional e-learning (Vries, Bersin, 2004).

Designing course for e-learning requires consideration of curricular obligations, available development tools and materials, but it also requires careful analysis of teaching and learning techniques. A modular design of rapid e-learning course can facilitate teaching, course design, delivery, and well growth of students. Lecture modules provide tutorials, scripts, interfaces, flexibility and richness for classes.

The course modules also should offer the instructor the ability to enhance, interrupt, change order of materials to be covered, or deliver chronological and sequential of instruction. Modular course architecture consists of a core framework combined with the required modules to build a custom-tailored course (Jeny et al, 2006).

Modern information technologies (IT) are becoming an integral part of an educational process. Education institutions need to gain more with low costs from their IT investments. Virtualization technology help to reduce operational costs, increase security, availability, and provide new learning scenarios.

The IT change provides to improve the quality of the education (Targamadze et al., 2010). One of the alternative solutions in the IT world is virtualization technologies that have a significant influence on the teaching-learning process (Kurilovas and Dagiene, 2009).

This paper presents modular rapid e-learning as a framework with desktop virtualization together to reduce costs, improve availability, and enable new learning scenarios and fast learning development process.

This study is original because it combines desktop virtualization and modular rapid e-learning as a new hybrid use in education field that brings about a fundamental change in end-user computing and educational environment. The main research objective is to evaluate the effectiveness of the desktop virtualization technology with modular rapid e-learning, comparing with traditional system in the context of educational outcomes, student opinions about hybrid system and its cost.

MODULAR COURSE DESIGN CONCEPT

Modular course design enables flexibility in providing interchangeability, transferability and portability of digital learning objects as well modules and course materials (Hai-Jew, 2009). The modules can be optimized independently of other modules; failure of one module does not cause other modules to fail. In modular design, one can replace or add any module without affecting the rest of the system without technical help (Bliss, 2008). In modular design, one module can be re-used in other systems. Thus modules can be reviewed, edited, and implemented by different people (Berners-Lee, 2008).Kelly (2009) summarizes advantages of modular design as follows:

- **Expedited course creation,**
- **Simplified course updates,**
- **Consistency for users.**

Instructional Strategies in a Module

The concept in a module is to bring together related contents that can be defined as a unit, chapter, topic, or segment of instruction. It is a standard "self-contained" chunk of instruction.

A module refers to the chunking of the content conceptually and practically. Thus the course is a combination of one or more than one modules.

In module design related contents are clustered into a module. Subject-based modules may be formed around a type or class of an object. Also a module may be organized around a particular activity or problem-based learning task (Hai-Jew, 2009).

Module Structure

The basic structure of a module has learning objectives and learning outcomes. All the contents and resources within the module should support the objectives and outcomes (Hai-Jew,2009). Learning objectives are specific statements, actions, performance criteria, and conditions of what students will be able to do upon completing the module.

A module should contain granular digital learning objects, multimedia contents, activities, assignments, discussions, practices, virtual experiences and simulations, and assessments (Boise State University, 2013). Modules may include some or all of the following elements as in figure: 1.

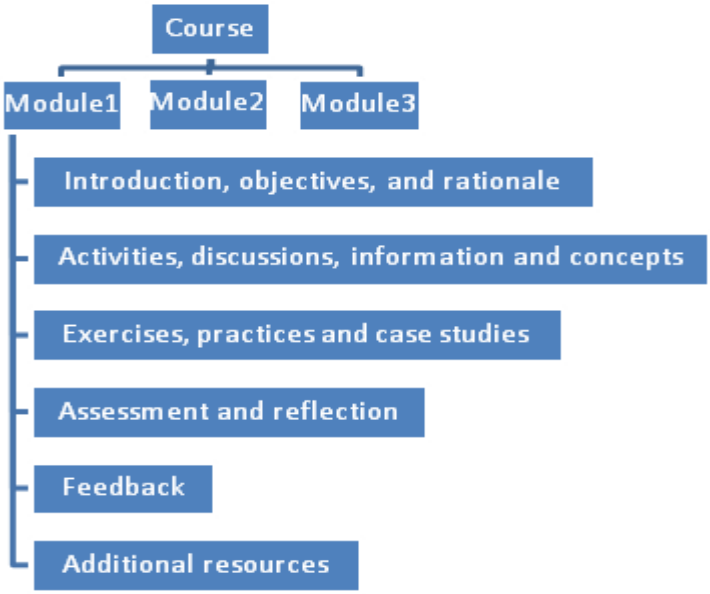


Figure: 1
Module Structure

Setting the Objectives

The objective for modular content specifies how it should be used. Without objective learning resources can't be successfully developed for the learning object. One way to determine the best approach is to decide what skill is required to demonstrate competency of the objective. Students should be able to recall information fairly easily requiring a very low level cognitive skill – memory recall (Crowder, 2011).

Content Development

Modular content refers to a collection of learning resources developed as a single learning object. Each learning object functions like a building block – independent and self-contained but capable of being paired with other building blocks. When an online course is built using a collection of learning objects, it is considered to be built using modular course design. Scholarly text-based materials, are mostly edited, proofed and designed in an appropriate layout. When use of audio-based materials, they feature excellent sound quality. In the case of audio-visual presentations, they feature excellent sound quality and appropriate visuals to reflect what is being said. Materials that do not meet scholarly publishing standards may reduce the ability to be successfully pair for a learning object with other learning objects (Henne, 2007).

Interactivity

Interactivity contains using text, voice and visuals. Live broadcast of visual aids may offer rich body language and facial expressions to enhance the audio and visual communications. Immersive 3D spaces offer venues for individuals to communicate via digital materials (Henne, 2007).

Activity

Learning activities in web based education have become richer such as digital games. There are experiential simulations, digitized practices and full sensory discovery learning spaces. In each module there should be interactive activity for the entire class or for groups, which encourages critical thinking and practical application of the material covered in the learning module. In web-based courses links can be given to the rich resources on the Internet and publisher websites to enhance learning and stimulate students' curiosity to dig deeper into the subject matter (Henne, 2007).

Assessments

Assessments should offer the satisfactory completion of the module. Assessments may involve simple perusal of modular contents for very low value assessment. Medium and high-value assessments may involve more specific evaluation of finer points of the learning within a module(Hai-Jew,2009) . Each module should include an activity before taking part in the learning activities within the module. The results can be compared to assessment results at the end of the module to measure learning outcomes. The end-of-module assessment should be in the same format as the pre-assessment to measure student progress (Henne, 2007).

RAPID E-LEARNING CONCEPT

Vries and Bersin (2004) saw that instutions have rushed into e-learning, but the time and cost were very high. This was a disadvantage. The two authers made a study "Rapid E-Learning: What Works" that builds e-learning programs in short time and in low cost. Elizabeth West (2007) declared that rapid e-learning addresses both less time and low cost issues by using technology tools to shift the dynamics of e-learning development. Kineo (2012) stated that they were looking forward to continuing in rapid e-learning approach in education field. E-learning Minds stated that today's business needs change very often. Information used on the jobs has very short shelf-life. Preparing and disseminating relevant and timely information and instruction to the right people in a short time frame has become the main challenge for most training departments (E-learning Minds, 2012).

In education the field of knowledge is a crucial factor, since it is shorter than ever. Rapid e-learning can be very helpful in supporting teachers and students with access to the up-to-date

knowledge and developments. By rapid e-learning, practical training programs can be created in a short period of time. In this context the characteristics of rapid e-learning are as follows:

- **Courseware can be developed in less than 4 weeks,**
- **Subject matter experts act as the primary source for development,**
- **User friendly simple authoring tools are used to integrate content and media,**
- **Learning duration is normally less than 20 minutes,**
- **It requires lower level of investment,**
- **Courseware has short shelf-life,**
- **It makes use of existing or available media from other sources (Vries, Bersin, 2004).**

Rapid e-learning is not always the only solution to answer training needs but it is important to assess the needs of organization and then design the instructions to meet those needs; this includes methods of developing the instruction. And also not all contents can be developed in the rapid e-learning method. Rapid e-learning is best used for instruction that focuses on lower learning level such as knowledge and comprehension in which content is available and usable. It is suitable for frequently updated and time-sensitive content. Rapid e-learning is used to generate awareness and to recall information (Bersin, 2005). Dunkleberger (2011) stated that rapid e-learning is used when want to generate awareness, recall information, apply knowledge to specific situations, and master the knowledge.

Rapid E-learning Development Tools and People

There are many tools available for rapid e-learning. These tools are designed for simplicity and integration with desktop applications to output instructional content that is available to use (Dunkleberger, 2011).

Most of them convert content using these applications into different formats. There are many applications to produce learning elements as follows (HELM, 2013):

PowerPoint to Web Converters

The tools retain the animation sequences produced within PowerPoint and provide a means to add a narration to the slides. They also provide a user interface that allows the learner control over the progression of the materials.

Screen Capture Movies

Tools such as Camtasia and Captivate allow non-technical authors to record screen actions as a 'movie' or video clip. These are used extensively in training applications and help documents to illustrate screen actions graphically, and are particularly useful where text descriptions would be over-long.

Software to add interactivity

A wide range of utilities, free and commercial, are available which allow non-technical authors to easily create simple interactive e-learning features, such as assessments, crosswords, drag and drop exercise, and so on .

Web Editing Tools

These applications enable to quickly develop small interactive website for teaching purposes.

Content Creation Tools

Brainshark, CourseAvenue, Articulate Presenter, Trivantis Lectora and Macromedia Breeze can be used. Rapid e-learning programs usually incorporate some type of live webcasting technology.

Web Conferencing Services

Microsoft LiveMeeting, IBM/Lotus Sametime, WebEx, Skype, Openmeetings can be used to deploy rapid e-learning with conferencing synchronously.

E-Learning Course Platform

A web-based e-learning course platform can be used to manage users, courses, notes, plug-ins, security, reports and course content. An open source software like MOODLE easily can be used for e-learning course design.

The ideal people are Subject Matter Experts (SMEs) to produce rapid e-learning. However most SMEs don't know how to design Web pages, graphic design and don't have instructional design background. They are knowledgeable about their audience, what they demands and how to present the information in different formats. When organizations want to create effective e-learning they should make an instructional designer (ID) available to SME. An ID knows how to present the information for maximum effectiveness. For rapid e-learning authoring tools need to be simple to use and must be content-focused, not much graphics-focused. For rapid e-learning speed of implementation of content, and the ability to use non-specialists override other considerations (Rosen, 2011). SMEs develop the material and deliver to the target audience. The ID becomes the coach on the side, help with designing the participant interactions for e-learning course and act as an invaluable resource to aid in the SME's success (Vries, Bersin, 2005).

In rapid development the discussion is on the facts and the results which are more important than theories and prejudices against technologies. A shared understanding among the professionals should be made to build trust and avoid 'quick and dirty' effect and non-fast prototyping case (Boulet, 2009).

Modular Rapid E-Learning Development Process

Rapid development depends on quicker system development. Timescale lessens by reducing and pruning some steps. ADDIE (Analysis, Design, Development, Implementation, and Evaluation) can be used and applied to develop rapid e-learning (Mcneill, 2007*).* The production of the storyboard is in the design step is time consuming. To remedy this situation, a new development life cycle paradigm was proposed by Punyabukkana et al. This development life cycle is known as Rapid eLearning Authoring and Development (RELAD) (Punyabukkana et all, 2006). In RELAD, no storyboard is produced. Process would entails joint-user and in-class explained course materials development by which content is segmented and fed into e-learning authoring tool (Parlakkilic, Karslioglu,2013).

Modular Design in rapid e-learning approach is directly connected to Design and Development phases steps. From the modular point of view, learning platforms as a set of independent modules that are built separately from each-other, thus this framework to identify situations, methods, and subjects that can initiate the modular design during the design and development process. The design and development processes are well integrated, and the e-learning frames will be used as the storyboard with live presentation. Modular Design improve the production time by eliminating storyboard and replacing the production model with live-interactivity and real digital assets. The production meet the user expectation since it is joint-user and in-class

explained course materials development. Basically, each module based designed rapid e-learning course can be developed as a framework in figure: 2.

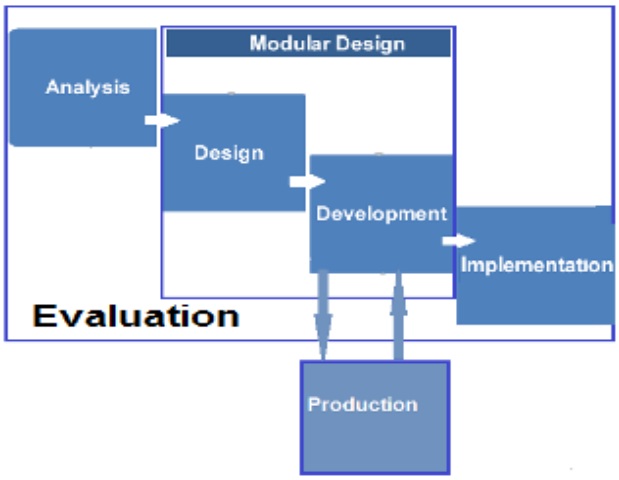


Figure: 2
Modular Rapid E-Learning Framework (MORELF)

DESKTOP VIRTUALIZATION IN EDUCATION

Before exploring the benefits desktop virtualization, it's important to have a grasp of the technology itself. Virtualization concept for the first time introduced in 1960s describes how different operating systems could coexist on the same mainframe computer. The concept of the virtualization widely has been expanded today. Desktop virtualization takes the efficiencies offered through a centralized processing environment and merges it in a traditional PC (Bruce, 2011).

Virtualization is a technology for hiding the physical characteristics of computing resources to simplify the way in which systems, applications, or end users interact with available resources. Many virtualization technologies exist in the literature. Some of them are; Server Virtualization, Storage Virtualization and Desktop Virtualization.

Server Virtualization is a technology to share single server hardware as multiple servers; these partitioned servers act as individual independent servers to serve the different requests. Storage Virtualization is a technology to provide virtual storage: it is "the abstraction at any layer in the storage software and hardware stack". It provides huge storage, independent of local machine hard disk capacity. So the study material from subject experts can be placed in single place. Desktop Virtualization is a technology to have multiple cores in a single die. It can provide virtual machines with different platforms; these virtual machines give an opportunity to student to get exposure in any platform and any application (Anisetti *et al.*, 2007).

***Institutions* have employed virtual technologies to address advantages associated with the modern technologies in many IT based courses (Miseviciene *et al.*, 2011). There are many studies that have implemented virtualization platforms in the teaching and learning process. Murfy and McClelland (2009) introduced virtual computer laboratory. The virtual computer laboratory provides scalable, high performance computing resources requested through an internet browser and accessed through either a remote desktop connection or secure client.**

Dobrilovic and Zeljko (2006) presented the opinion of how virtual network laboratories were used in an operating system course. Lunsford (2010) investigated the use of virtualization in a business-oriented information system security course. The paper focuses on the formulation and implementation of policies for information assurance, desktop security, and the examination of security measures. Results proposed in the paper of Fuertes *et al.* (2009) focus on the effective usage of virtualization platforms. Galan *et al.* (2009) analyzed implementation of Computer Network Laboratories for the teaching-learning process. Giguere (2009) demonstrated benchmarked successful completion rates for online academic courses and compared those to off-line course benchmarks. Peng (2008) shares his experience on using virtualization technologies in information technology course.

A recent survey of higher education IT professionals tells that 76 percent of these experts have already identified the solution to their computer lab. challenge: virtual desktop delivery. The survey highlights concerns about the maintenance-intensive computer lab and also illuminates the benefits that colleges and universities can expect from the virtual environment (Citrix, 2009). IT Consultant Kınacı (2013) in The Education Volunteers Foundation of Turkey (TEGV), Turkey's most widespread Non-Governmental Organization operating in the field of Education, assessed traditional thin clients and after investigation some virtualization technologies chosen NComputing's technology as revolutionizing the desktop virtualization platform. TEGV has future plans to extend the use of this technology to its Educational Parks, Learning Units, and Mobile Learning Environments throughout Turkey. As a result, the increased utilization of Information and Communications Technology (ICT) in the activity centres and extracurricular learning centres will improve the quality of learning for all citizens in Turkey.

Desktop virtualization allows multiple desktop environments to run on a single physical machine. General desktop virtualization consists of a centralized server and client devices without local storage that utilize the centralized server as their processing and data engine. Virtual desktop has three major computing architectures:

- **Shared Desktop/Presentation Virtualization: A server-based computing architecture that supports shared desktops include Microsoft Remote Desktop Services, Citrix XenApp and nComputing.**
- **Virtual Desktop Virtualization (VDI): A variation of the client/server that allows multiple discrete desktop operating systems to be hosted within virtual machines running on a server.**
- **Remote Physical Desktop: A desktop computing architecture that allows users to access a remote blade dedicated per user work station hosted in a data center (Li, 2011).**

Shared desktop is the most cost-effective solution and meets the needs. On the server side, a shared desktop/remote desktop services solution that can support from 20 to 100 students per host computer. On the client side, compatible multi-seat client devices provide user authentication, network/server access, remote display, and peripheral connectivity (Li, 2011).The end users access the virtual desktop from a zero or thin-client machine that has minimal local storage, processing power or software or they may open a virtual window on a traditional PC (Bruce, 2011).

Challenges and Benefits of Virtualization in Education

Wide usage of computers has increased student, instructor, and staff access to information and computing resources and this has become a double-edged sword at many facilities. Computer

devices can be found in any area in schools such as mobile laptops that are shared across classrooms; computers in labs, libraries and classes; the office machines used by staff and administrators. The presence of many machines has also become a management challenge for IT staffs. The following issues represent key challenges:

- **Software and hardware maintenance: Managing individual PCs (maintaining the machines, updating software, dealing with security issues, installing patches, and troubleshooting) has become more than a full-time job for current staffing levels of IT employees and contractors.**
- **Student access and support for devices: Many schools cited goals of having one machine per student and enabling anytime, anywhere student access to tools via their own devices for enhanced learning. Supporting applications on non-school devices and providing a consistent experience for students pose significant resource challenges.**
- **Budget constraints: Aging hardware, upgrading operating system, high costs per machine and software licenses combined with severe, local budget constraints place institutions under pressure (Bruce, 2011).**

Despite these challenges, students, teachers, and administrative staff increase or refresh the numbers of machines at their schools, and desktop virtualization offers the following advantages:

- **Security: Locking down user configuration settings and protect all corporate data in one centralized location.**
- **Data protection: Desktop virtualization enables more efficient and effective protection of this data by moving it from the endpoint to the data center.**
- **Disaster Recovery: Desktop virtualization enables to extend high-availability, disaster recovery and business continuity to the desktop. This provides a greater fault tolerance and reliability while providing higher levels of availability to end users.**
- **Optimizations: The financial benefits of desktop virtualization can include extending endpoint refresh cycles, reducing IT labor requirements via streamlined desktop administration, and mitigating the risk of lost user productivity by enabling more consistent access to applications and data (Clarke, McCarthy, 2011).**

METHOD

In the study, modular course design and rapid e-learning were used together. The rapid e-learning system has been developed using Moodle (Modular Object-Oriented Dynamic Learning Environment). Every teacher was trained for eight hours per person about using Moodle, and modular rapid e-learning course design and development principles. The instructor of the course has enough computer skills and can design content. For course development, a template was created and used by teachers.

Thereafter all teachers and assistants created course contents according to modular rapid e-learning course design principles and upload directly to e-learning. All students were trained for using Moodle four hours per student.

Participants and Instruments

The sample group was consisted of 120 nursing students of 3rd grade enrolling "The Structure of Human and Nature" in the first semester of the current academic year. During traditional class learning, the students were supported with rapid e-learning method on virtual desktop system in web environment. In the previous academic year 120 nursing students of 3rd grade took "the structure of human and nature" course only with traditional method with the same teacher. The outcomes of both groups were compared.

Students Final Exam

A final exam was conducted at the end of semester. The questions and teachers were the same for both year. For statistical analysis SPSS for Win. Ver. 20.0 (SPSS Inc., Chicago, IL., USA) application was used. For statistical decisions $p<0.05$ level was accepted as meaningful difference indicator.

Student Opinions

An interview was made with students in order to explore opinions towards the hybrid system.

Modular Rapid E-learning Building Process

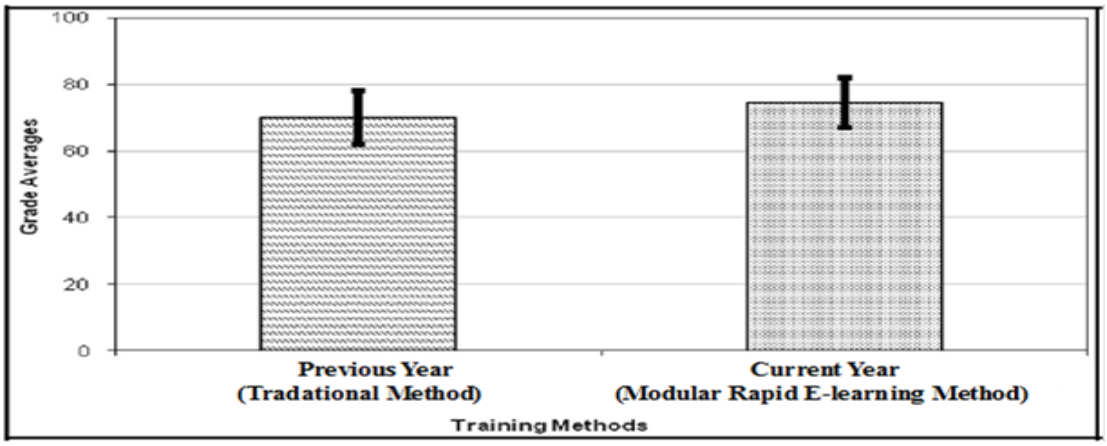
The model for rapid e-learning development involves an instructor with the required experience. All teachers in the school have enough skills to design content and other course materials.

Virtual Desktop Building Process

Desktop virtualization system building process is explained with simple steps.

RESULTS

For both groups students' exam grades comply with the normal distribution and were examined graphically with Shapiro-Wilk test. Descriptive statistics of grades are shown with mean ± standard deviation. For both years students' grades calculated by using paired samples t test in order to compare results. Number of students in this study was 120 for each year. In previous year students' average score by traditional method was Figure: 3



Grade Averages According to training methods

69.99 ± 8:01 " but in current year students' average score as shown in Figure1 increased to 74.50 ± 7:57 by using rapid e-learning supported traditional method. Because of using rapid e-learning supported traditional method students' grade in next year increased. This increase was due to using rapid e-learning as a supported position and it is determined as 4.51 ± 11:05 rated 95% in confidence interval. This increase was at least 2.41, at most 6.60. Statistically it is meaningful due to using different training method (t = 4256, p <0.001).

Student Opinions for Hybrid System

In order to get students' opinions for modular Rapid E-learning an interview was made. We mentioned rapid e-learning course platform as "course platform" in interview.

Student opinions are as follows:

Access and Using the System Easily

All of the students said it is easy to access and use the system do not need any training.

The Performance and Response Time of the Course Platform

93 students (%78) said that the system is working with average speed and moderate but 27 students (%22) said that they faced with uploading and downloading problems during rush hours.

Adequacy of Content and Materials in Course Platform

88 students (%73) said that course materials and course content are enough but need to be developed more interactively and 32 students (%37) said that external resource links should be given.

Interaction during Learning

All of the students said that they used email and chat in working hours with their friends but 72 students said that they were not responded by their teachers asynchronously. By looking at the student opinions it was concluded that for system performance it is essential to optimize system by regulating hardware and software according to used applications. Another conclusion is to build more interactive course content and lastly the teachers should answer student questions on time.

Modular Rapid E-learning Building Process

All teachers and student have been informed and trained about virtual desktop system and rapid e-learning system. The course platform for rapid e-learning has been Moodle. The course building process is as follows:

- **The teacher develops content according to modular rapid e-learning process, reviews and adds instructional value.**
- **The teacher develops the assessment and ensures that it maps the objectives.**
- **If the teacher doesn't have enough skills, s/he calls on a consultant for design,**
- **The teacher uploads the content to the Moodle.**
- **Teacher updates and revises content and what is necessary.**

Virtual Desktop Building Process

Desktop virtualization system was set up in three computer laboratories. Three virtual desktop computer labs and three virtual desktop servers were set up each for 40 virtual desktops. Office programs, antivirus programs and operating systems were only set up on virtual desktop server

and also a portion of disk space and memory were dedicated to each student for their virtual desktops. Desktop virtualization system was set up according to following steps by IT people:

- **Datacenter/Server hardware installation,**
- **Creating Master virtual server,**
- **Install operating system on master virtual machine,**
- **Install software, feed subject materials, and other contents on master virtual machines,**
- **Clone a backup of master virtual machine,**
- **Create client virtual machines to provide access,**
- **Access to the system.**

Cost of the Hybrid System

A typical tradational computer lab costs more than $1,000 per seat. This high cost means some schools and even universities are only able to provide limited technology resources to their growing student population at a time when technology has become a part of everything for academic success. The advantages provided with desktop virtualization are as follows:

- **Increasing the size of the computer classroom without increasing budget,**
- **Reduce maintenance and support costs by 75% ,**
- **Reduce power and cooling requirements by 90% ,**
- **Build more flexible and smaller footprint labs, maximizing classroom space,**
- **Reduce device theft and loss (Kom, 2012).**

When we look at modular rapid e-learning, the key reasons for investing in modular rapid e-learning is to reduce the cost of e-learning development and speeding up the development. While rapid e-learning may incur some of the same hard costs as traditional e- learning, in reality its cost base and approach are quite different. The obvious place for cost savings in rapid e-learning is in the development of materials (Kineo, 2012). Based on our expenses for the project, hardware, IT support and software cost were reduced by 41% comparing with traditional e-learning and computing system.

CONCLUSION

In this study desktop virtualization technology and a modular rapid e-learning system was developed for teaching and learning environment. In a typical e-learning system, a design is implemented so that it meets a set of requirements at the time of development. Often, after delivering, the users want to add functionality, or different users will require custom functionality based on specific needs. In order to accommodate these situations without a complete re-write, a framework that allows for future additions of modules without breaking the available module needs to be implemented. Design flexible and scalable system architecture with modules is a way to publish and maintain a modular rapid e-learning course easily and effectively.

This hybrid system can be used for quick and urgent needs as a supportive e-learning course. The teachers can easily construct and upload courses and are eager to use the system. The students use this hybrid system on demand and it provides them a paperless environment. It was seen that there is a meaningful increase in average points of students by using rapid e-learning supported traditional method as at least 2.41, at most 6.60. Statistically the results are

meaningful due to using rapid e-learning supported traditional method. This hybrid system provided a cost saving about % 41 comparing with traditional desktop and e-learning systems.

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